HOT CELL RADIATION TESTING AND INSPECTION

GPO PRICE $ _____

CFSTI PRICE(S) $ _____

Hard copy (HC) 2.00

Microfiche (MF) .50

ff 653 July 65

Prepared For:

GEORGE C. MARSHALL SPACE FLIGHT CENTER

Prepared By:

GEORGIA NUCLEAR LABORATORIES

GEORGIA NUCLEAR LABORATORIES

Lockheed-Georgia Company - A Division of Lockheed Aircraft Corporation

S/F 3.67 47

FOREWORD

This report is submitted to the Astrionics Laboratory of the George C. Marshall Space Flight Center, National Aeronautics and Space Administration, Huntsville, Alabama, in accordance with the requirements of Task Order No. ASTR-LGC-28 of Contract No. NAS 8-5332. The report describes the inspection and testing of the two hot cells located in Building No. 4475 of MSFC. The testing was performed by personnel from the Georgia Nuclear Laboratories, Dawsonville, Georgia.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

1.0 SUMMARY

A 300 millicurie Cobalt-60 Source was placed at the center of hot cell "B" at a height of 6 feet above the floor. Using a highly sensitive gamma radiation detector (sodium iodide crystal) the radiation level was measured at each external wall surface and at the roof area adjacent to hot cell "B". The process was repeated while substituting hot cell "A" for "B".

A 485 curie Cobalt-60 Source was then substituted for the 300 millicurie source and the entire mapping procedure repeated except in the roof area for each hot cell.

All data was recorded and is presented below in the "Results" section of this report.

2.0 INTRODUCTION

The hot cell inspection and testing described in this report was performed to assure MSFC that the radiation shielding requirements were met in the construction of the hot cell complex. This task was accomplished by measuring the amount of radiation leakage external to the cells from radiation sources placed within the cells.

3.0 PROCEDURE

The following procedure was used in inspection and testing of the hot cells and is similar to that suggested by MSFC .

3.1 INSPECTION

Inspect visually cell walls inside and outside, roof, ceiling, and floor for cracks; inspect window frames, door frames and manipulator ports for gaps.

3.2 TESTING

(1) Mark; e.g., with chalk, a grid of lines approximately 3 feet apart on the walls and roof of the hot cells, dividing them into sections of approximately 9 foot^2 area. Number each section.

(2) Check the calibration of all instrumentation.

(3) Place one of the alarming ratemeters (set to alarm at 5 mr/hr) against each outside wall of hot cell "B", and one against the crack under the cell door.

(4) Read background count rate of NaI counter system, outside each of the four sides of the hot cell block, inside each hot cell and on the hot cell roof.

(5) Place a 4cc ionization chamber inside hot cell "B", with its readout meter in the control room.

(6) Place the 300 millicurie Cobalt-60 Source (secured inside its shield) in the center of cell "B"

(7) Hold a survey meter at the hot cell viewing window, and slowly raise the source from its shield. Return it into the shield if the survey meter or alarm rate meters indicate over 5 mr/hr. If not, latch the source in the exposed position 6' above floor level.

(8) Quickly survey around the window and door frames and around all walls of the hot cell at waist level. If no reading above 5 mr/hr appears, proceed with inspection.

(9) Observe the ion chamber reading.

(10) With the NaI counting system make a one minute count, while moving the probe around at random above the surface of section #1 of hot cell side "A", keeping the probe within one foot of the cell wall. Repeat this operation for all numbered sections on the exterior of hot cell "B". Record all readings with background subtracted.

(11) Return the source to its shield.

(12) Repeat steps 3 through11, except substituting hot cell "A" for hot cell "B".

(13) Place the 485 curies Cobalt-60 Source (secured inside its shield) at the center of the floor of hot cell "B".

(14) Repeat steps 3, 4, 5, 7, 8, and 9.

(15) Do not permit any personnel to be on the roof of any portion of the radiation lab whenever the 485 curie source is unshielded. With the NaI counting system, make a one minute count, while moving the probe

around at random in the numbered section #1, keeping the probe within one foot of the wall surface. Repeat this operation for all numbered sections external to cell "B" except for the roof area. Record all readings with background subtracted.

(16) Replace the source into its shield.

(17) Repeat steps 3, 4, 5, 7, 8, 9, 14, and 16 except substituting hot cell "A" for hot cell "B".

(18) Replace the source into its shield.

4.0 RESULTS

Inspection and testing of the two hot cells located in Building 4475 at Marshall Space Flight Center was completed July 23, 1965. This task was accomplished according to the testing procedure suggested by MSFC with the deviations and results given below.

A visual inspection of the cells revealed no faults except in the roof area of both cells. The roof area over each cell contained several small cracks. Subsequent testing with radiation sources proved that the radiation leakage through the cracks was insignificant unless the source was placed at the crack. A comparison of radiation transmission through solid concrete and through a crack indicated an increase in the radiation level by a factor of two (2) through the crack.

The cell walls and roof were marked off in 3' x 3' sections (approximately) and numbered as shown in the sketches below. Some sections had larger areas but in each case they were located where shielding was at a maximum thickness.

The 300 millicure Cobalt-60 Source was placed at each cell center and 6' above the cell floor. Leakage radiation (in excess of natural background) was measured at each wall and roof section. The results for each section were tabulated and reported in the tables below.

Background radiation increased sharply at sections 13, 26, 39 and 52 on Side A. This increase was determined to be caused by the relatively high radioisotope content of the concrete blocks in the wall adjacent to these sections.

No radiation levels were reported as being less than 0.001 mr/hr above background since background was approximately 0.01 mr/hr and fluctuated as much as 10 percent.

The 485 curie Cobalt-60 Source was placed in the center of each cell 6' above the floor level and the previous measurements repeated except for the roof area where a portable survey meter was used. The highest radiation level observed was 30 mr/hr directly over the source on the cell roof.

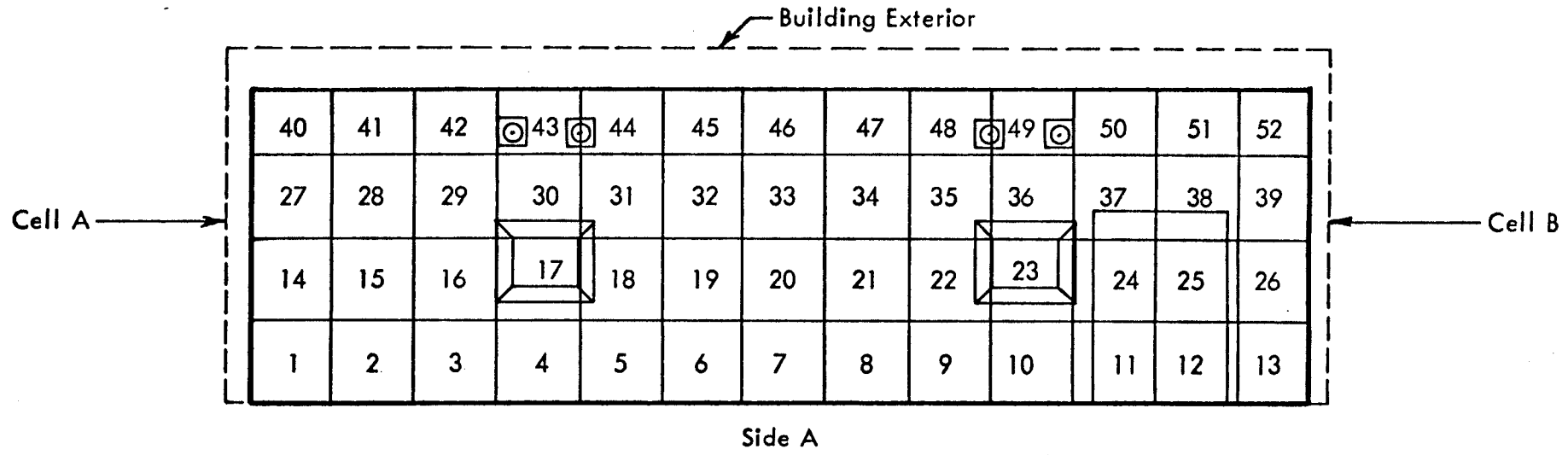
Reasonably high leakage dose rates were observed near and at manipulator ports and at the cracks underneath the cell doors. With the source at the center of each cell and 6' above the floor level, a survey meter was used to determine the highest dose rate at the manipulator ports which was 3 mr/hr. It should be noted that under these conditions the source was near alignment with the axis of the manipulator port holes. This condition would rarely occur during normal hot cell utilization. The source was then moved to different positions around the cell doors and the highest dose rate observed was 0.5 mr/hr through the crack at the lower edge of the cell doors. Leakage through and around windows was no greater than that observed through solid 5' concrete walls.

4" Wall

247	248	249	250	251	252	253	254	255	256	257	258	259
234	235	236	237	238	239	240	241	242	243	244	245	246
221	222	223	224	225	226	227	228	229	230	231	232	233
208	209	210	211	212	213	214	215	216	217	218	219	220
195	196	197	198	199	200	201	202	203	204	205	206	207
182	183	184	185	186	187	188	189	190	191	192	193	194
169	170	171	172	173	174	175	176	177	178	179	180	181

Cell A → ← Cell B

FIGURE 1 ROOF AREA



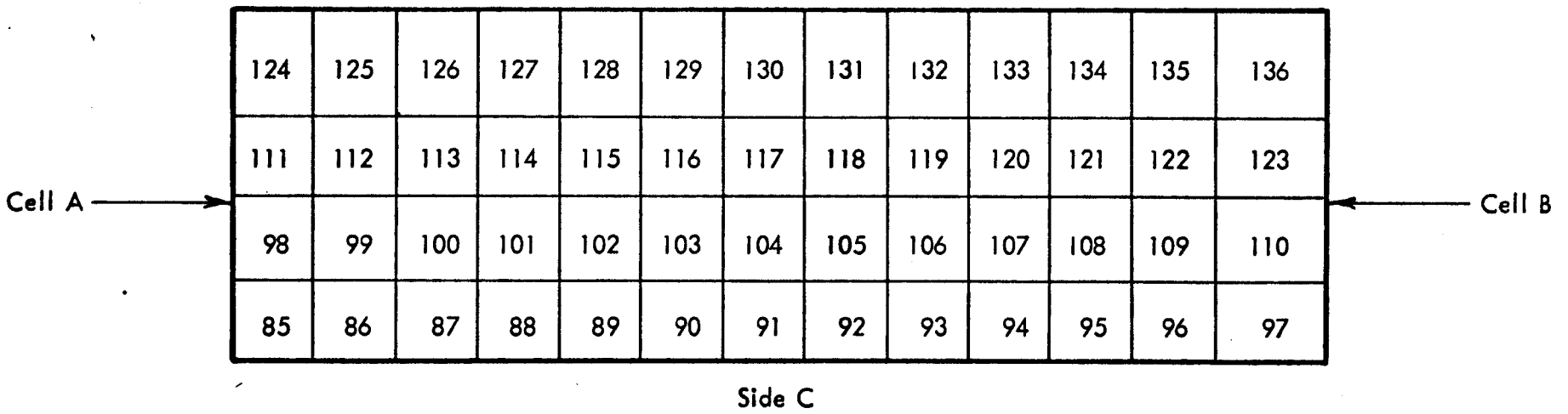


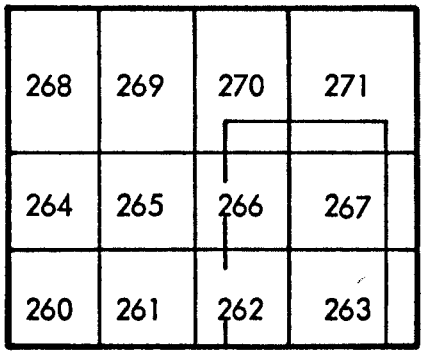
FIGURE 2 SIDE A AND SIDE C

Joins Side A								Joins Side C
77	78	79	80	81	82	83	84	
69	70	71	72	73	74	75	76	
61	62	63	64	65	66	67	68	
53	54	55	56	57	58	59	60	

Side B

Joins Side C								Joins Side A
161	162	163	164	165	166	167	168	
153	154	155	156	157	158	159	160	
145	146	147	148	149	150	151	152	
137	138	139	140	141	142	143	144	

Side D



Side E
(Inside Cell A)

FIGURE 3 SIDE B, SIDE D, AND SIDE E

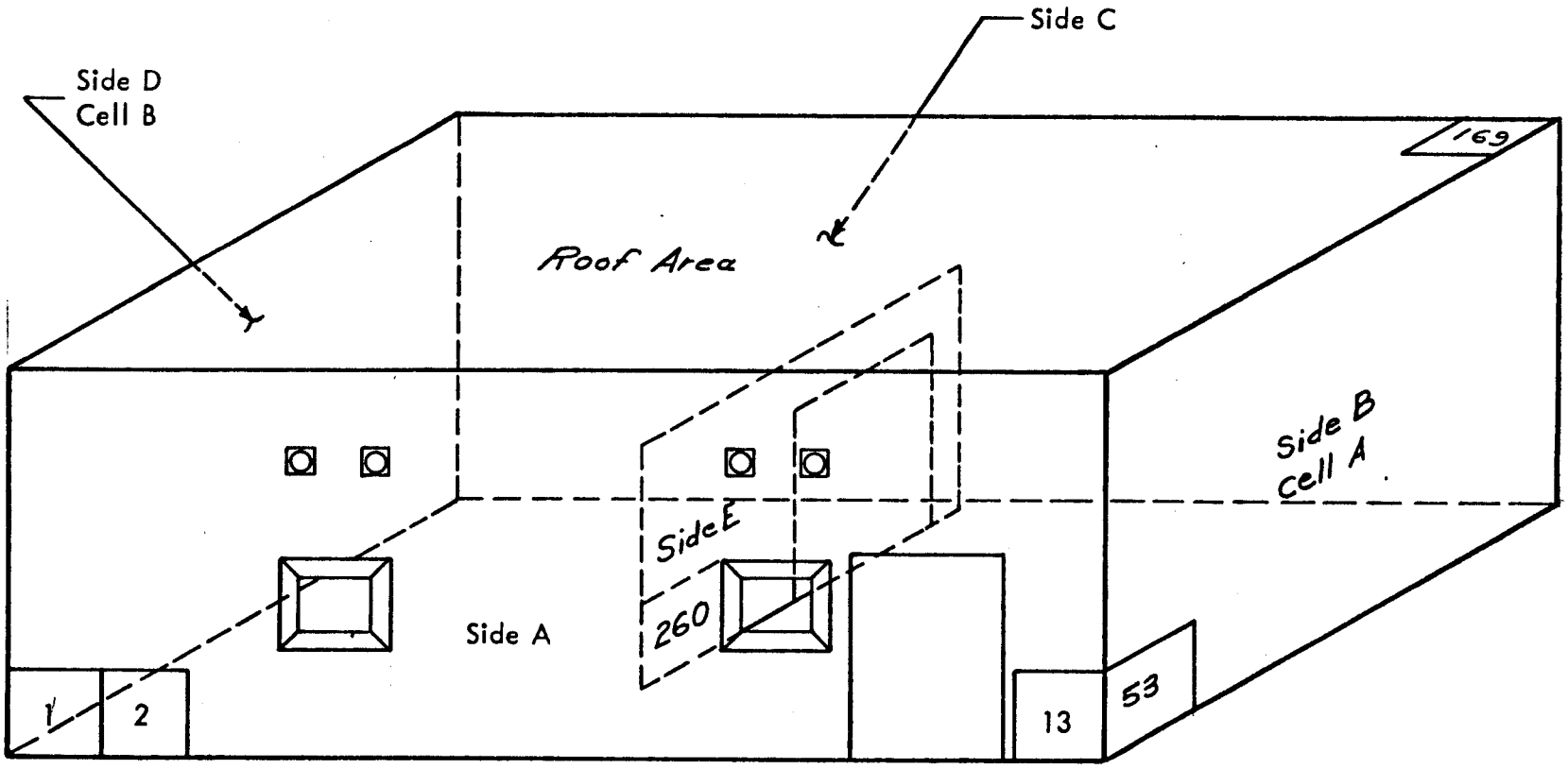


FIGURE 4 HOT CELL NUMBERING

TABLE 1 WALL MAPPING
300 MC

Side A		Side C	
Position Number	Dose Rate mr/hr	Position Number	Dose Rate mr/hr
1	.001	85	.001
2	.001	86	.003
3	.002	87	.002
4	.001	88	.001
5	.001	89	.001
6	.001	90	.001
7	.001	91	.001
8	.001	92	.002
9	.001	93	.002
10	.001	94	.001
11	.001	95	.001
12	.001	96	.001
*13	.007	97	.001
14	.001	98	.001
15	.001	99	.002
16	.001	100	.001
17	.001	101	.001
18	.001	102	.001
19	.003	103	.001
20	.001	104	.001
21	.001	105	.001
22	.001	106	.001
23	.001	107	.001
24	.001	108	.002
25	.003	109	.001
*26	.006	110	.001
27	.001	111	.003
28	.001	112	.003
29	.001	113	.001
30	.001	114	.002
31	.001	115	.002
32	.002	116	.001
33	.001	117	.001
34	.001	118	.002
35	.001	119	.001
36	.001	120	.001
37	.001	121	.001
38	.002	122	.001
*39	.005	123	.001

TABLE 1 WALL MAPPING (Continued)
300 MC

Side A		Side C	
Position Number	Dose Rate mr/hr	Position Number	Dose Rate mr/hr
40	.001	124	.003
41	.002	125	.004
42	.001	126	.001
43	.001	127	.001
44	.001	128	.001
45	.001	129	.002
46	.001	130	.001
47	.001	131	.002
48	.001	132	.001
49	.001	133	.003
50	.001	134	.001
51	.002	135	.001
*52	.007	136	.001

* Adjacent to concrete block wall.

TABLE 2 WALL MAPPING
300 MC

Side B		Side D		Side E	
Position Number	Dose Rate mr/hr	Position Number	Dose Rate mr/hr	Position Number	Dose Rate mr/hr
*53	.006	137	.002	260	.001
54	.004	138	.001	261	.001
55	.001	139	.003	262	.001
56	.001	140	.002	263	.001
57	.001	141	.001	264	.001
58	.001	142	.001	265	.001
59	.001	143	.002	266	.001
60	.001	144	.002	267	.001
*61	.006	145	.002	268	.001
62	.002	146	.001	269	.001
63	.001	147	.003	270	.001
64	.001	148	.004	271	.001
65	.001	149	.001		
66	.001	150	.001		
67	.001	151	.001		
68	.001	152	.001		
*69	.008	153	.001		
70	.002	154	.001		
71	.001	155	.001		
72	.001	156	.001		
73	.001	157	.001		
74	.001	158	.001		
75	.001	159	.001		
76	.001	160	.001		
*77	.002	161	.001		
78	.001	162	.001		
79	.001	163	.001		
80	.001	164	.001		
81	.001	165	.001		
82	.001	166	.001		
83	.001	167	.001		
84	.001	168	.001		

* Adjacent to concrete blocks.

TABLE 3 ROOF MAP
300 MC

Position Number	Dose Rate mr/hr	Position Number	Dose Rate mr/hr
169	.002	224	.022
170	.001	225	.014
171	.001	226	.003
172	.001	227	.001
173	.001	228	.001
174	.001	229	.008
175	.001	230	.014
176	.001	231	.008
177	.002	232	.001
178	.002	233	.001
179	.001	234	.001
180	.001	235	.002
181	.003	236	.005
182	.004	237	.006
183	.005	238	.005
184	.008	239	.002
185	.012	240	.001
186	.009	241	.001
187	.003	242	.002
188	.001	243	.004
189	.002	244	.003
190	.007	245	.001
191	.010	246	.001
192	.004	247	.003
193	.001	248	.002
194	.001	249	.002
195	.001	250	.002
196	.002	251	.002
197	.014	252	.001
198	.039	253	.001
199	.020	254	.001
200	.006	255	.001
201	.002	256	.001
202	.003	257	.001
203	.018	258	.001
204	.026	259	.001
205	.016		
206	.003		
207	.001		

TABLE 3 ROOF MAP (Continued)
300 MC

Position Number	Dose Rate mr/hr	Position Number	Dose Rate mr/hr
208	.002		
209	.003		
210	.019		
211	.050		
212	.032		
213	.009		
214	.002		
215	.005		
216	.024		
217	.045		
218	.020		
219	.006		
220	.002		
221	.001		
222	.002		
223	.010		

TABLE 4 WALL MAPPING
485 Curies

Side A		Side C	
Position Number	Dose Rate mr/hr	Position Number	Dose Rate mr/hr
1	.002	85	.001
2	.001	86	.001
3	.001	87	.002
4	.003	88	.002
5	.005	89	.004
6	.005	90	.001
7	.002	91	.001
8	.004	92	.001
9	.004	93	.001
10	.003	94	.001
*11	.027	95	.001
*12	.028	96	.003
13	.004	97	.001
14	.001	98	.004
15	.001	99	.002
16	.006	100	.001
17	.007	101	.001
18	.007	102	.001
19	.007	103	.001
20	.003	104	.002
21	.006	105	.006
22	.006	106	.004
23	.005	107	.001
24	.006	108	.001
25	.007	109	.001
26	.004	110	.001
27	.001	111	.001
28	.003	112	.003
**29	.015	113	.005
**30	.030	114	.001
**31	.024	115	.001
32	.005	116	.001
33	.002	117	.005
**34	.009	118	.005
**35	.034	119	.001
**36	.018	120	.008
**37	.010	121	.006
38	.005	122	.004
39	.005	123	.005

TABLE 4 WALL MAPPING (Continued)
485 Curies

Side A		Side C	
Position Number	Dose Rate mr/hr	Position Number	Dose Rate mr/hr
40	.001	124	.010
41	.004	125	.008
***42	.017	126	.009
***43	.143	127	.001
***44	.056	128	.001
45	.004	129	.001
46	.003	130	.008
47	.008	131	.002
***48	.085	132	.001
***49	.069	133	.001
50	.006	134	.001
51	.007	135	.001
52	.004	136	.008

* Bottom of cell door

** Manipulator Vacinity

*** Manipulator Port

TABLE 5 WALL MAPPING
485 Curies

Side B		Side D		Side E	
Position Number	Dose Rate mr/hr	Position Number	Dose Rate mr/hr	Position Number	Dose Rate mr/hr
53	.002	137	.001	260	.002
54	.001	138	.001	261	.005
55	.001	139	.001	*262	.083
56	.005	140	.001	*263	.042
57	.008	141	.001	264	.002
58	.001	142	.001	265	.004
59	.001	143	.001	266	.004
60	.001	144	.001	267	.004
61	.001	145	.001	268	.002
62	.001	146	.001	**269	.007
63	.001	147	.002	**270	.010
64	.004	148	.003	271	.002
65	.009	149	.001		
66	.001	150	.001		
67	.001	151	.001		
68	.001	152	.001		
69	.004	153	.001		
70	.001	154	.001		
71	.001	155	.001		
72	.001	156	.002		
73	.007	157	.001		
74	.002	158	.001		
75	.001	159	.001		
76	.001	160	.001		
77	.001	161	.001		
78	.001	162	.001		
79	.001	163	.001		
80	.001	164	.001		
81	.003	165	.001		
82	.001	166	.001		
83	.001	167	.001		
84	.001	168	.001		

* Bottom of door

** Door Crack

REFERENCES

(1) Letter dated 4-21-65 from Mr. W. T. White, MSFC, to Lockheed Aircraft Company, Lockheed-Georgia Co., Marietta, Ga.